REMARKS

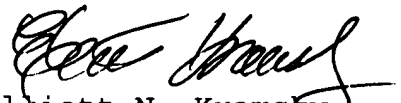
Claim 1 of the substitute specification is amended herein prior to receipt of a first office action.

The amendment to Claim 1 corresponds to that made by Applicant's attorneys on November 17, 2004 in response to the PCT Written Opinion issued September 17, 2004 in International patent application PCT/EP03/08441. The International Preliminary Examination Report issued December 7, 2004 in the International patent application (the present application is the U.S. National Phase of the International application) is positive with regard to novelty, inventive step and industrial applicability in view of amended claim 1 and original Claim 2.

A paragraph has been inserted into the specification. Such paragraph corresponds to a like addition made to the text of German patent application 102 45 526.0 made by the Applicant's German attorney's letter dated October 8, 2004.

No new matter is added by any of the amendments made herein.

Respectfully submitted,



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Title: SPECTRALLY BROADBAND LIGHT SOURCE OF HIGH OPTICAL POWER

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BACKGROUND

Field of The Invention

The invention relates to a spectrally broadband light source ~~of spectral broadband type of~~. More particularly it pertains to a high optical power light source for use in fiber optic applications ~~in particular for use in~~ such as fiber optic interferometers and fiber optic gyroscopes (FOGs).

Description of The Prior Art

Superluminescent diodes have been used ~~to date~~ as light ~~source~~ sources in fiber optic sensors (FOGs, in particular) ~~in order~~ to insure the two central requirements of ~~on the one hand~~ (1) spectral broadbandedness and ~~on the other hand, adequate~~ (2) optical power adequate for launching ~~to be launched~~ into the fiber. Such light sources are special components that are ~~comparatively very~~ relatively expensive ~~because of~~ due to their low ~~piece~~ numbers. Commercially available, inexpensive alternatives ~~would be~~ include light-emitting diodes (LEDs) ~~or~~ and laser diodes (LDs). LEDs do not fulfill the optical power criterion~~, but on the other hand~~ while LDs do not ~~exhibit~~ possess the required spectral properties ~~to be required~~.

SUMMARY AND OBJECTS OF THE INVENTION

It is therefore ~~the~~ an object of the present invention to provide a spectrally broadband light source of high optical power for fiber optic applications that can be produced ~~cost effectively in~~ by means of an economic automatic mass production process ~~and thus in large piece numbers~~.

The present invention addresses the preceding and other objects by providing a spectrally broadband light source of

~~comparatively~~ high optical power for fiber optic applications. ~~in particular for fiber optic sensors~~ Such light source is characterized by a monolithic linear array, arranged on a substrate, in particular a wafer or chip, of adjacent surface-emitting LEDs~~,~~ and a microoptics array arranged upstream of the monolithic LED linear array on the emission side at a prescribed spacing, having optical functions individually assigned to the LED elements in such a way that, for the purpose of optimizing the optical power that can be launched into an optical fiber, the emission of the individual LEDs is focused onto an optical unit arranged upstream of the launch point of the fiber.

The optics unit is preferably designed as a spherical lens arranged at an end of the fiber into which light is radiated.

The foregoing and other features of the invention will become further apparent from the detailed description that follows. Such description is accompanied by a drawing figure. Numerals of the drawing figure, corresponding to those of the written description, point to the features of the invention with like numerals referring to like features throughout both the written description and the drawing.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is a diagram of the layout of a spectrally broadband light source in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

~~Thus~~ The ~~idea of the~~ invention consists in the ~~suitable~~ combination of a number of available techniques and elements ~~that are basically available, specifically:~~ , including high power LEDs, precise microoptics for beam focusing of the ~~lights output by~~ outputs of the individual LEDs, and ~~a suitable further~~ optics

for optimally launching the focused optical power into an optical fiber.

The actual light source is an array, preferably a lens array, in combination with high power, surface-emitting LEDs. The criterion of spectral broadbandedness ~~can be~~ is met with the latter. Such LEDs can be completely tested on the common wafer. The array consists of LEDs, adjacent, at a small spacing, on the wafer. The ~~respective~~ number of ~~which~~ LEDs employed is determined by the ~~subsequent~~ following optical units for beam deflection and focusing as well as ~~by~~ the optical power required.

~~A~~ Special microoptics is mounted on the monolithic LED array~~. This optic~~ that consists of an array of individual optical functions ~~in order to focus~~ for focusing the more or less three-dimensional emissions of the individual LEDs on the chip into a ~~respectively~~ parallel emission. The high optical power criterion ~~of the desired~~ is met by this summing of ~~the individual~~ optical powers of the individual LEDs. The use of ~~the most recent~~ current methods in ~~from~~ the field ~~fields~~ of microoptics yields ~~a~~ complex optical functionality in conjunction with very good adaptation to the LED array. The focusing is ~~performed here~~ very ~~precisely~~ precise in adaptation to the individual LEDs of the array and is, if appropriate, optimized for each ~~of those LEDs~~ LED of the array with regard to ~~the~~ direction of emission. ~~These~~ Such requirements can be ~~implemented~~ achieved very effectively with ~~the aid of a~~ microoptics, specifically in a monolithic fashion in a single module. A further optics unit, for example a spherical lens mounted at the end face of the fiber is used for beam focusing and for optimizing the launch into the fiber.

~~An exemplary embodiment of the invention is explained below in detail with reference to the drawing of Figure 1 (sole figure).~~

Turning to the drawing, Figure 1 is a diagram of the layout of a spectrally broadband light source in accordance with the invention. The light source is constructed on a substrate 1, in particular a suitable wafer or chip substrate. ~~is~~ A linear array of preferably-equally-spaced high power and surface-emitting LEDs 3 that can all be completely tested directly on the wafer with the aid of known test methods is arranged along a reference line or edge 7. ~~is~~ A lens array 4, each of whose individual elements ~~4 are~~ is respectively aligned ~~in each case~~ with one of the LEDS 3 is located a short spacing in the direction of the emission of the LEDs 3. The optical elements of the lens array 4 are~~, for their part, fashioned~~ arranged and aligned ~~such~~ so that the light beams of the individual LED elements 3 are focused onto ~~a~~ collecting optics 5 ~~that is preferably a collecting optics 5, for example~~ (e.g. a spherical lens) arranged upstream of or on an optical fiber 6.

The following substantial advantages are achieved ~~with~~ by the invention:

1. Essential processing and testing steps ~~can~~ may be carried out as batch processing. This leads to substantially lower production costs, in particular in the case of chip production and in comparison with the costs for production of a single superluminescent diode having ~~comparable~~ like properties.

2. The production of ~~the~~ a chip with the LED linear array and the lens array ~~is~~ can be performed ~~using~~ by known ~~of~~ mass production processes.

3. The ~~chips~~ chip can be adapted ~~comparatively~~ relatively easily to the ~~respective~~ current state of the art, ~~in order~~ easily ~~to utilize a~~

utilizing growth potential ~~of this novel technique which~~ that is ~~mastered~~ accomplished in ~~principle~~ theory by ~~a~~ the majority of chip manufacturers.

Apart from fiber optic sensors, the invention is also suitable for specific applications in metrology, in particular, ~~in~~ telecommunications, ~~that is to say~~ and wherever ~~a~~ spectral broadbandedness is required~~, for example in the~~ (e.g. measurement/calibration of WDM or DWDM systems).

While this invention has been described with reference to its presently-preferred embodiment, it is not limited thereto. Rather, the invention is limited only insofar as it is defined by the following set of patent claims and includes within its scope all equivalents thereof.

What is claimed is:

1. A spectrally broadband light source of high optical power for fiber optic applications, characterized by

(a) a monolithic linear array, arranged on a substrate, in particular a wafer or chip, of adjacent surface-emitting LEDs; and

(b) a microoptics array arranged upstream of the monolithic LED linear array on the emission side at a prescribed spacing, having optical functions individually assigned to the LED elements in such a way that, for the purpose of optimizing the optical power that can be launched into an optical fiber, the emission of the individual LEDs is focused onto an optical unit arranged upstream of the launch point of the fiber.

2. A spectrally broadband light source as claimed in Claim 1, characterized in that the optical unit is designed as a collecting optics, in particular as a spherical lens, arranged at an end of the fiber into which light is radiated.

ABSTRACT

A spectrally broadband light source of high optical power for fiber optic applications. ~~comprises according to the invention the combination of~~ A number of LEDs are arranged as a monolithic array of adjacent surface-emitting, bright, on a wafer or chip. A microoptics array is arranged upstream of the monolithic LED linear array on the emission side, for focusing the light beams emanating from the LEDs. ~~and the use of a further~~ Collecting optics in particular a spherical lens, is provided for optimizing the optical power to be launched into a ~~respectively provided~~ fiber.

~~The broadband light source according to the invention is suitable, in particular, as a particularly moderately priced replacement for superluminescent diodes in fiber optic sensors, in particular in fiber optic gyroscopes.~~